BEACH EVALUATION STUDY

NORTH SCITUATE BEACH

NORTH SCITUATE, MASSACHUSETTS

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASSACHUSETTS 02154

OCTOBER 1970

BEACH EVALUATION STUDY

NORTH SCITUATE BEACH

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BEACH EVALUATION STUDY

NORTH SCITUATE BEACH

NORTH SCITUATE, MASSACHUSETTS

1. General. This is a study of the present-day function of the existing beach erosion control project for North Scituate Beach, Massachusetts. The purpose of the study is to evaluate the stability and effectiveness of the project as constructed and of the accompanying nourishment program to determine if the project design and nourishment program should be modified at this time. Field observations and surveys reveal that very substantial changes have occurred in the design dimensions since construction of the project by the Commonwealth of Massachusetts in February 1967. This evaluation is made with the latest design principles in mind. This includes a study of wave induced processes, correlated with storm tide levels, field observations and comparative beach surveys.

2. Location and Description. North Scituate Beach is located in the town of Scituate, about 20 miles south of Boston. It was included in the beach erosion control study made of the shore between Pemberton Point and Cape Cod Canal in cooperation with the Commonwealth of Massachusetts in 1959. Local interests desired a protective and recreational beach at North Scituate Beach. The 1957 study recommended a method of construction based on information from local interests. The Beach Erosion Board recommended that North Scituate Beach be recommended for Federal participation. A supplemental report completed by NED in 1958 developed the economic justification necessary for project authorization.

The project, adopted by the River and Harbor Act of 1962, provides for Federal participation of one-half the first cost of construction which consists of widening 2,500 feet of beach to a 125-foot width behind the mean high water line, by direct placement of suitable sandfill. It further provides for Federal participation equal to one-half of the cost of periodic nourishment of the project for a period of 10 years from the year of completion of the initial beach restoration. The beach fronts massive concrete walls. The seriously damaged sections of the walls have been reinforced by massive rock revetment.

3. The Problem. The problem involves the rapid loss of beachfill that has been experienced during the two years since construction of the project at which time the Commonwealth placed 160,000 cubic yards of fill on the beach, (about 80 cubic yards per foot of beach). The beach has greatly diminished in width along most of the length with a general lowering of the beach berm. This is particularly true along the northern half of the beach, where the loss of sand now exposes the concrete apron structure fronting the seawalls.

4. The problem results from storms occurring during higher than normal tide levels. Storm-driven waves attack and overtop the beach. The storms are frequent. Erosion of the backshore allows larger waves to runup and overtop the beach, thus reaching the seawalls. The massive concrete walls backing most of the beach, then aggravate the problem by reflecting the waves back on the beach. Where seawalls are fronted by rock revetment, the reflection forces are reduced which apparently has helped maintain a wider berm than at unrevetted sections.

5. Design Analysis. This study considers the primary component factors causing the problem which include storms and design tide, wave heights, including an on-site investigation, have helped evaluate the problem. The factors are discussed as follows:

a. Design Tide and Storms. The more frequent damaging storms are from the northeasterly quadrant. A southeasterly storm occurs on rare occasions. The northeast storms, rather than hurricanes, cause the major shore problems north of Cape Cod. The normal tide range is 9.0 feet with the spring tide estimated at about 10.5 feet above mean low water. The highest tide ever recorded at Boston Harbor was 14.2 feet above mean low water on 29 December 1959. The tide levels at Scituate are 0.7 feet lower than Boston levels. Thus, this record tide was 13.5 at Scituate.

Frequent winter storms produce tides approaching 12.0 feet above mean low water. As recently as May 1967, a severe storm caused a tide level of 13.5 feet at Boston or an equivalent of 12.8 feet at Scituate. This study considers a tide level of 13.0 feet at Scituate which is estimated to occur about once in five years.

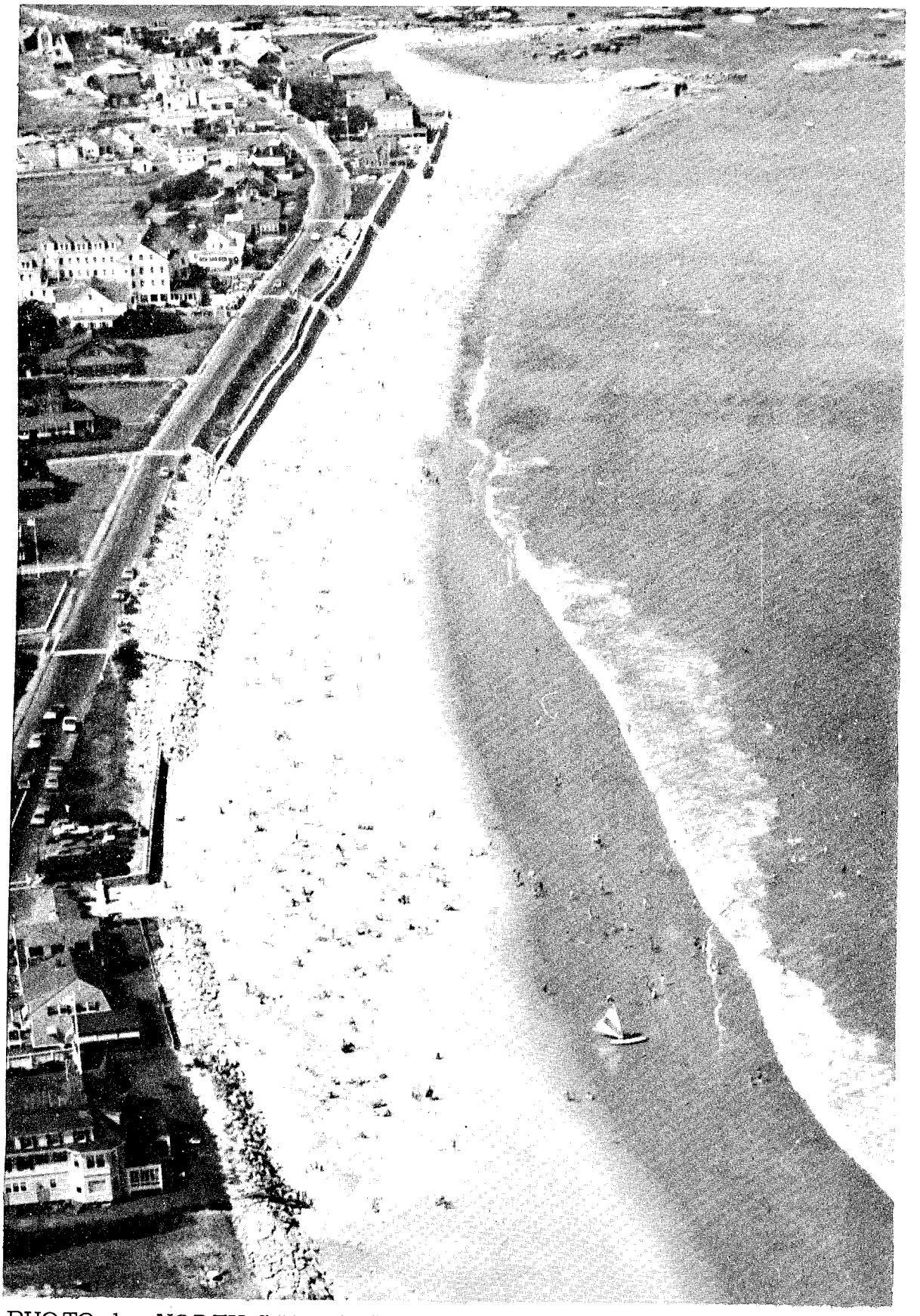

PHOTO 1. NORTH SCITUATE BEACH, JULY 1967. Near high tide looking north along newly constructed beach.

b. Wave Height. Hindcast studies are based on the Nauset Beach wave rose as shown on Plate No. 1 and as tabulated in Technical Report No. 55, prepared by Beach Erosion Board "North Atlantic Coast Wave Statistics, Hindcast by Bretschneider, Revised Sverdrup Munk Method". The deep water wave height of 15 feet with a period of eight seconds was selected as being representative during easterly storms. The more frequent storm waves approach from the east-northeast, closely followed by easterly waves with the east-southeast waves experienced on rare occasions. A wave height of up to 10 feet based on available depth within the beach area is representative for the design tide condition.

c. Wave Runup. Wave runup computations have been made for a once a year storm 12.0 feet above mean low water and also for a design storm of once in five years (13.0 feet above mean low water). The computations include consideration of a larger breaking wave at about the mean low water line and a smaller breaking wave at the mean high water line. The computations are based on beach slopes of 1 vertical on 20, 15 and 12 horizontal, to allow for realistic and expected changes in slope after construction. As indicated in Table 1, the runup reached elevations nearly 3 feet above the constructed backshore level for the design storm for the steeper beach slope of 1 on 12. This slope closely approximates the adjusted slope experienced during winter storm conditions.

d. Wave Refraction. A wave refraction analysis has been made for each of the storm-driven wave approaches as illustrated by the orthogonal plots on Plate Nos. 11 through 13. A study of the plots discloses that a concentration of wave energy is experienced at sporadic locations. Offshore shoals direct wave lenses to these particular points. The intensity of this concentration of wave forces is demonstrated by the improvement measures within this area, where massive revetment has been constructed fronting seriously damaged seawalls.

The refraction analysis indicates a southerly drift along the northern half of the improvement, toward the area of central convergence as caused by the more frequent east-northeast and easterly approaching waves also bending northerly along the southern sector with a northerly component of drift to the central converging area. The east-northeast waves continue with a southerly component south of the area of convergence. The east-southeast storm-driven waves, occurring less frequently, have a continuous northerly component except at the area of convergence.

TABLE 1

WAVE RUNUP COMPUTATIONS

Beach Slope	(1) Backshore Beach Elev. M. L. W.	Breaking Zone	Stillwater Level M. L. W.	Wave Ht. Ft.	Wave Runup Ft.	of Runup M. L. W.
1 on 20	15.0	M. L. W.	12.0	9.5	2.6	14.6
1 on 20	15.0	M. H. W.	12.0	5.5	2.1	14.1
1 on 20	15.0	M. L. W.	13.0	10.0	2.7	15.7
1 on 20	15.0	M. H. W.	13.0	6.25	2.2	15.2
1 on 15	15.0	M. L. W.	12.0	9.5	3.6	15.6
1 on 15	15.0	M. H. W.	12.0	5.5	2.7	14.7
1 on 15	15.0	M. L. W.	13.0	10	3.6	16.6
1 on 15	15.0	M. H. W.	13.0	6.25	3.0	16.0
1 on 12	15.0	M. L. W.	12.0	9.5	4.7	16.7
1 on 12	15.0	M. H. W.	12.0	5.5	3.7	15.7
1 on 12	15.0	M. L. W.	13.0	9.5	4.8	17.8
1 on 12	15.0	M. H. W.	13.0	5.5	3.6	16.6

(1) Backshore beach elevation of constructed project.

PHOTO 2., 6 OCTOBER 1970. Looking north along reveted section of beach. Note narrowness of beach berm at near high tide.

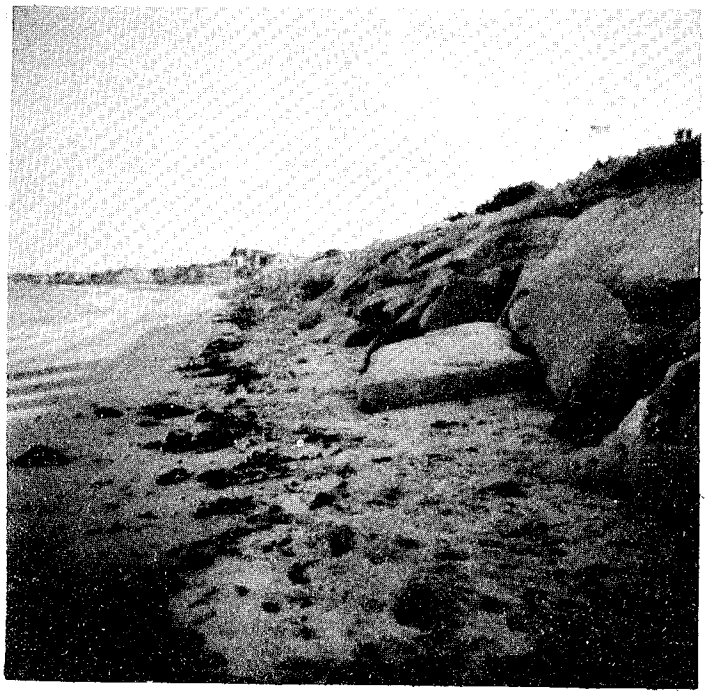

PHOTO 3., 6 OCTOBER 1970. Near high tide, looking south along southern one-third of beach. Little dry beach as demonstrated by wave runup line of deposited seaweed, near toe of revetment.

e. Comparative Profiles & Shoreline Changes. Fourteen beach profiles surveyed in the years 1965-1967 and 1969 are shown on Plate Nos. 2 through 4 and plotted on Plate Nos. 5 through 10. These surveys show the physical dimensions of the beach immediately before and after construction (1965, 1967) with the 1969 profile showing the advanced stage of erosion. The hydrography was limited to the nearshore depths in the interest of economics and as a "condition survey" for maintenance purposes rather than for study. As shown on Plate No. 14, "Shoreline Changes", the mean high water line moved landward as much as 70-90 feet in the two years since the structure was completed along most of the northerly three-quarters of the project. Comparative volumetric computations of beach fill change, show losses totaling about 90,000 cubic yards, have been experienced in the 2 years following construction. Proportionately this includes nearly 100 percent loss for much of the northern half with 40 to 70 percent for much of the southern half. No accretion appears along the backshore area although minor accretion within the nearshore area has occurred to some sectors. There has been no apparent build up of the beach observed between storms during periods of beach building swells. Although a more extensive analysis would be required, based on hydrography to greater depths to better determine movement of sand within the nearshore area, it is believed to be mainly offshore, with alongshore movement being confined generally seaward of the toe of the beach.

6. Recapitulation of Authorized Project and Project Justification (1958 study). The formulation and justification of the authorized project was based on development of a practical and economically feasible protective and recreational improvement as desired by State and local interests. The estimated cost of the project as computed in the cooperative beach erosion control report completed in 1958 was $160,000 for direct placement of 100,000 cubic yards of sand. It was then estimated that 3,000 cubic yards of fill would be required annually for necessary periodic nourishment at an annual cost of $4,500. The annual charges were then $10,100.

7. In the cooperative study, it was estimated that there were about 500 dwellings located within convenient walking distance of the beach with an average family size of 4 persons. Therefore, about 2,000 persons were within convenient walking distance of the beach. It was estimated that on weekends and holidays, guests of shore residents averaged one person per dwelling. There were then 2,500 persons that would probably visit the beach at least once during peak day use. Based on a parking lot with spaces to provide parking for 250 cars, 4 passengers per car, and a turnover of two during each peak use day, there would be an additional 2,000 visitors from beyond walking distance.

8. The annual benefits as computed for the cooperative study were $2,300 for a reduction in damage prevention costs for the seawalls, and $16,250 annually for recreational bathing use. This was based on $.25 for a single visit (then considered reasonable for a beach with a minimum of parking facilities), for the increased use of the improvement, totaling $16,250 for 65,000 visits, based on a 26 peak day use by 2,500 people for the added beach area. The available beach before construction was then adequate for 1,700 people (not exceeded on week day use), with an increase in capacity of 2,500 after construction or a total of 4,200 people without crowding for the completed project.

9. The justification of the project was largely determined by the expected recreational use requirements. The damage prevention benefits contributed to a lesser degree. The estimated annual periodic nourishment requirements become a major factor affecting the annual cost of the project. The periodic nourishment requirements had to be estimated largely on a judgment basis with no positive method available to measure losses from the area. The breakdown of the annual costs and benefits as developed in the cooperative study are tabulated below:

Item		Annual Cost
Interest		$ 4,000
Amortization		1,600
Periodic Nourishment	3,000 c.y. x $1.50	4,500
	Total Annual Charges	$ 10,100
Protective Benefits		2,300
Recreational Benefits		16,250
	Total Benefits	$ 18,550
Benefit to Cost (1)	18,550/10,100	1.8

(1) Benefit to cost, if 15,000 c.y. nourishment/year had been used (15 percent of volume of sandfill) equals 0.65.

10. Based on the experienced losses that have occurred since the construction of the project in 1967, the periodic nourishment requirements would have averaged 45,000 cubic yards a year or in excess of 40 percent of the total volume of fill per year. Even if a more realistic 15 percent of the total volume of fill had been assumed as a periodic nourishment requirement, instead of the assumed 3 percent, the project would not have been economically justified. The rapid loss of beach fill, apparently through frequent wave runup accompanied by large offshore losses by wave reflection, point to a need for considering modification of the existing project.

PHOTO 4., AUGUST, 1969. Storm-driven waves have damaged sections of a concrete faced stone wall along a sector of backshore extending northerly of similar wall protected by revetment.

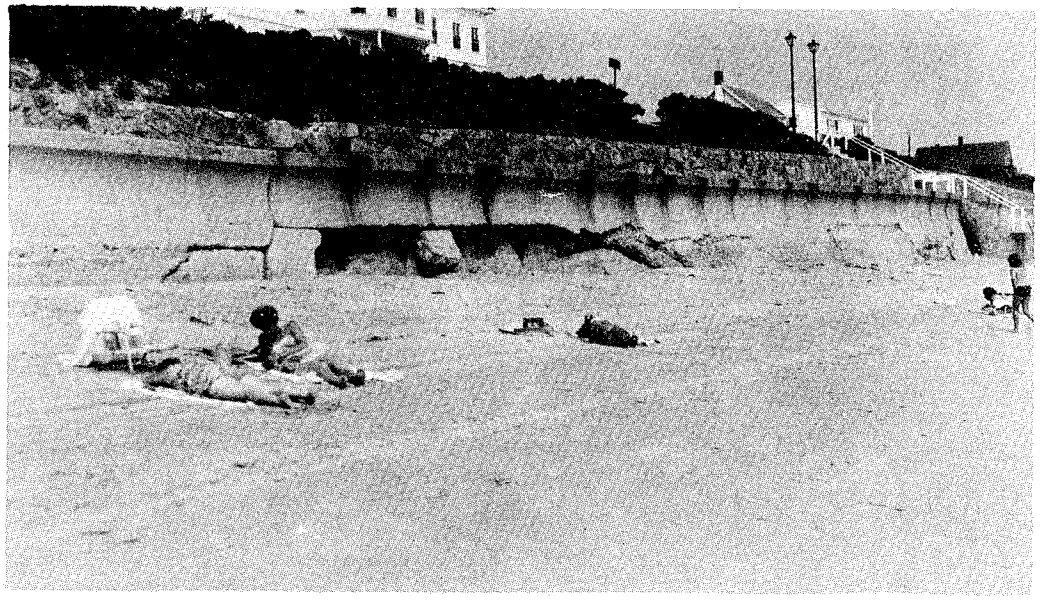

PHOTO 5., AUGUST 1969. Looking along another section of seriously damaged wall within the same sector as shown in PHOTO 4.

11. Considered Project Modifications. Consideration has been given to modification of the project in the light of better technical knowledge of wave induced processes and annual losses ascertained since completion of the cooperative study. Any offshore breakwater type construction to substantially reduce storm-driven waves is much more expensive than alongshore revetment or groin structures and therefore, cannot be economically justified. This type of construction also requires the addition of artificial fill required for recreational beach use in this area where massive alongshore improvements has reduced the natural beach building material to a minimum. The plans include raising and widening the beach, with and without groins, providing a beach with a 50-foot wide berm at elevation 17.0 feet mean low water (at about the elevation of maximum wave runup), with a seaward slope of 1 vertical on 15 horizontal to mean high water, thence 1 vertical on 20 horizontal. Also included is consideration of providing stone revetment along about 800 feet of seriously damaged wall, as a northerly continuation of existing revetment rather than the beach fill.

12. Cost of Considered Plans & Benefits. The cost of the plans as itemized in Table 2 range from $100,000 for the cost of the revetment to $840,000 for the cost of providing a beach estimated to be required for stability. The benefit to cost ratio of all plans, under the present conditions of development for the area are not economically justified. There has been no appreciable expansion of parking facilities since the completion of the study in 1958. An allowable per visit figure of $0.50 has been used based on the existing conditions of development.

13. This beach area is conveniently located to the Boston megalopolis, easily accessible to widely traveled modern thruways and nearby coastal routes. There is a great need for public use beaches, now at a premium with most of the shorefront in private ownerships. The addition of modern bathhouse facilities and expansion of nearby parking area would be required to accommodate the larger recreational populace resulting from a more stable project, see plan 4. An allowable per visit value of $0.75 per visit has been used for a project modification including expanded facilities. The increased use is based on a seasonal peak day increase of 200,000 visits with the existing beach probably adequate for the week day use visitation.

TABLE 2

COMPARATIVE COSTS - CONSIDERED PLANS

Plan	Description	First Cost	Annual Charges	Annual Benefits	Benefit to Cost
1	Revetment along damaged sector of wall	$100,000	$ 53,000	$ 2,500	.04
(1)(3) 2	Providing 50 ft. berm at el. 17.0 ft. above mean low water - with existing developments	725,000	100,000	35,000	0.35
(1)(4) 3	Plan 2 with groin - with existing developments	840,000	108,000	35,000	0.33
(2)(3) 4	Plan 2 with expansion of sanitary, bathhouse and parking facilities	725,000	100,000	152,500	1.5
(2)(4) 5	Plan 4 with groin	840,000	114,000	152,500	1.3

(1) Recreational benefits based on maximum available recreational populace with parking facilities and nearby residential development same as for cooperative study but using $0.50 per visit value assumed reasonable for undeveloped projects.
(2) Recreational benefits based on fully developed beach and $0.75 per visit value, maximum allowable under present regulations.
(3) Annual charges include annual periodic nourishment requirement of 20,000 c.y.
(4) Annual charges include annual periodic nourishment requirement of 17,000 c.y.

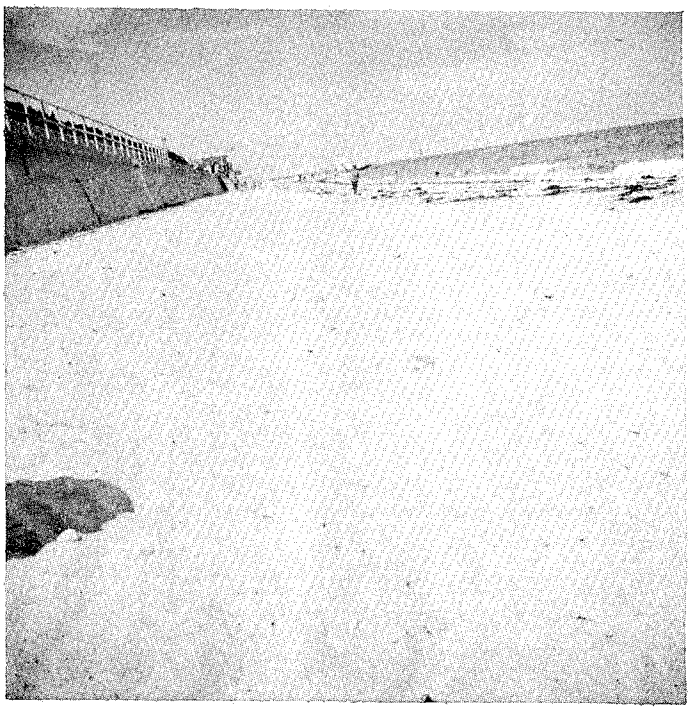

PHOTO 6., AUGUST 1968. Looking north along northern half of beach at near high tide. Note width of beach berm.

PHOTO 7., OCTOBER 1970. Looking north along narrow northern half of beach at near high tide. Note narrowness of beach compared to PHOTO 5.

14. Conclusions. The authorized project was developed in a cooperative study with the Commonwealth of Massachusetts in 1958 for construction by local interests based on their determination of economic justification. On the recommendation of the Beach Erosion Board in its review, the project was justified for Federal participation based on local interests assuming that certain legal requirements be met for public use of a private sector of shorefront within the project area. Key factors involved in the design and project justification are the storm-driven wave processes (particularly wave runup and reflection) the estimated and actual periodic nourishment requirements, and the available use populace.

15. The beach, as constructed, afforded very limited protection against wave action with the backshore elevation being at or close to the elevation of wave runup occurring during frequent severe storms. The beach, fronting massive vertical face concrete seawalls, has been subjected to substantial wave reflection resulting in large losses of beach material primarily offshore. The reflection forces become progressively greater with the continued lowering of the beach berm. Actually, the backshore elevation of the beach was constructed at elevation 15.0 feet above mean low water with frequent storms having a wave runup of up to 17.0 feet above mean low water or 2 feet higher than the constructed beach backshore. The beach sloped seaward on a slope of 1 vertical on 20 horizontal, thus offering very little protective beach berm fronting the walls. The computed annual losses of material experienced in the two years since construction averaged about 45,000 cubic yards or 15 times the estimated requirement.

16. The fact that the development of the area including residential property and parking use areas has not substantially changed since completion of the study, offers little or no growth in the recreational use to substantially increase the recreational benefits since the study was completed. It is concluded that renourishment of the authorized project to project dimensions would be impractical and not economically feasible; and that periodic nourishment requirements would continue to be excessively high. The addition of a strategically located groin structure for the existing project would not substantially reduce losses which are predominantly offshore through wave reflection.

17. It is also concluded, however, that in view of the great need for recreational use beaches in Massachusetts, particularly within the Boston megalopolis, that an economically feasible project could be developed by provision of a higher and wider beach berm for needed stability (largely in a reduction of losses from reflection from the seawalls). It would require expansion of existing sanitary and parking facilities to accommodate the additional recreational populace estimated in project justification with high periodic nourishment requirements. This would require that the Commonwealth of Massachusetts and the town of Scituate participate in a more costly project including the cost of further expansion of facilities. In lieu of a project with Federal participation, local interests can protect the seriously damaged section of concrete walls by extension of the existing stone revetment about 800 feet north along the damaged section.

18. Recommendations. In view of the complexity of the problems associated with the wave induced processes at this beach, it is recommended that the Coastal Engineering Research Center include this beach in their coastal evaluation study program, for analysis and recommendations of the future courses of action for the project.

19. It is further recommended that if CERC is generally in agreement with the findings of the study, that the town of Scituate and the Commonwealth of Massachusetts be advised that pursuant to their request, a resolution for further study for possible modification of the project similar to the completed Revere study, could be undertaken.

CORPS OF ENGINEERS

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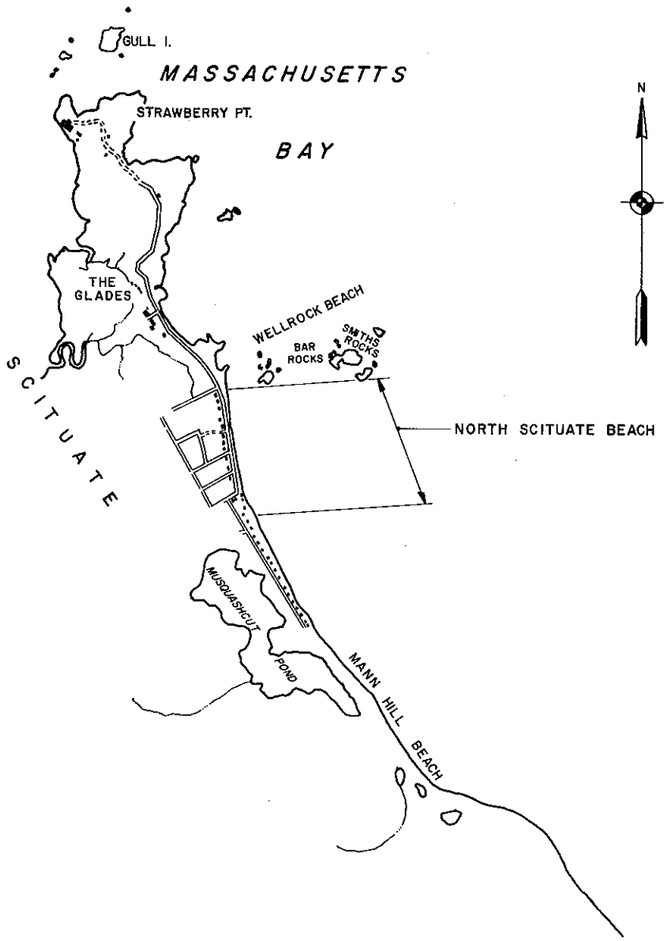
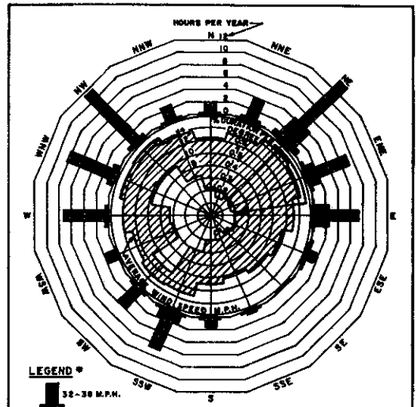




WIND ROSE

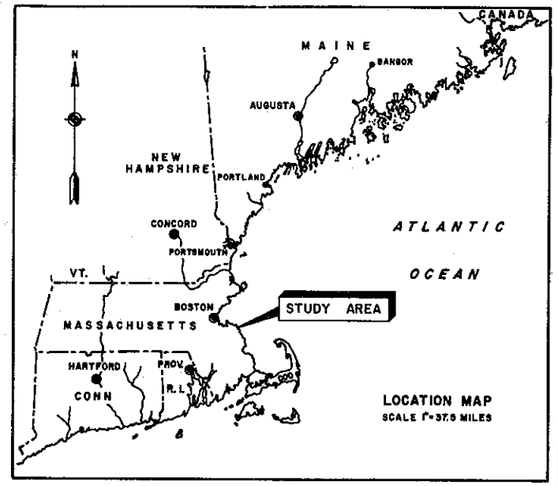
LOGAN AIRPORT, BOSTON, MASS.

OCTOBER 1949–SEPTEMBER 1959

10 YEAR RECORD

* DURATION FOR EACH RANGE OF WIND SPEEDS IS MEASURED OUTWARD FROM TOP OF UNDERLYING BAR GRAPH.

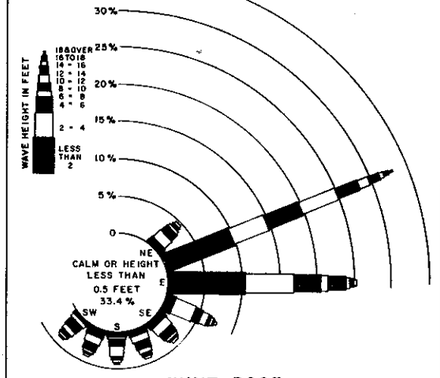
NOTE:
PERCENT DURATION PER DEGREE IS THE AVERAGE PERCENT DURATION OBSERVED FOR EACH 16 POINTS OF THE COMPASS DIVIDED BY 22 1/2 DEGREES.



LOCATION MAP

SCALE 1"=37.5 MILES

COMPOSED OF DATA OBTAINED BY HINDCAST OF 3 YEARS OF WIND RECORDS (1948-1950) SHOWING PERCENT OF TIME WAVES OF DIFFERENT HEIGHT OCCUR FROM EACH DIRECTION. FROM BEACH EROSION BOARD TECH. MEMO. NO. 55.



WAVE ROSE

OFF NAUSET BEACH, CAPE COD, MASS.

(LAT. 41° 50' N, LONG. 69° 30' W)

GRAPHIC SCALE
1" = 1000' 1000 0 1000 2000

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
SUBMITTED		
PROJECT ENGINEER		
CHIEF, COASTAL DEVEL. SECT.		
APPROVAL RECOMMENDED: CHIEF, PLANNING BRANCH	APPROVED: CHIEF, ENGINEERING DIVISION	DATE: OCT. 1970

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
LOCATION MAP

SCALE 1" = 1000'

DRAWING NUMBER

SHEET 1 OF 1

PLATE NO. 1

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SURVEY MADE MAY, 1965

GRAPHIC SCALE
1" = 100'
100 0 100 200

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
SUBMITTED		
PROJECT ENGINEER		
CHIEF, COASTAL DEVEL. SECT.		
APPROVAL RECOMMENDED		
CHIEF, PLANNING BRANCH		

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
SURVEY MAP

APPROVED
CHIEF, ENGINEERING DIVISION
DATE OCT. 1970

SCALE 1"=100'

DRAWING NUMBER

SHEET 1 OF 3

PLATE NO. 2

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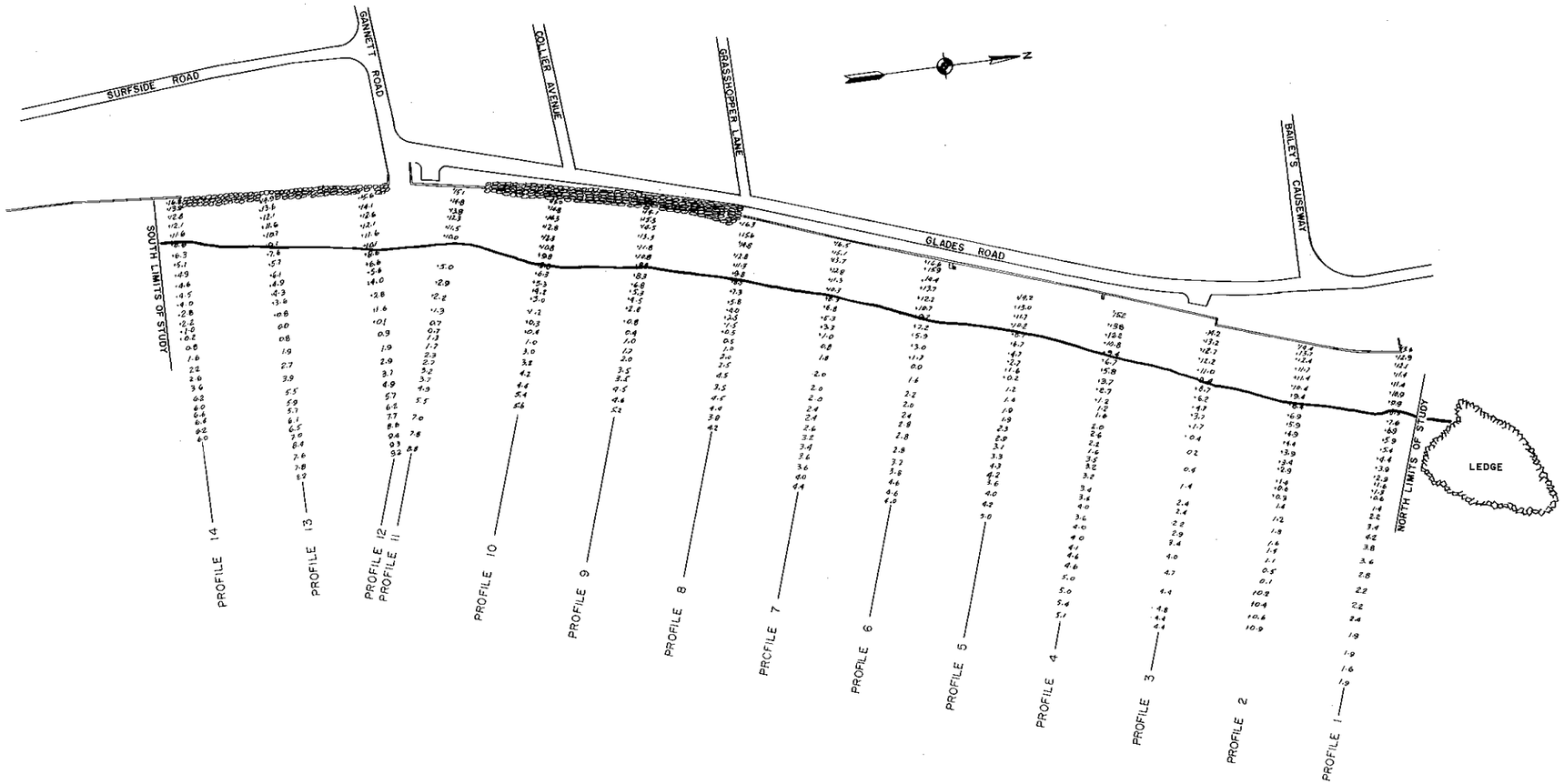

SURVEY MADE JAN. 1967

GRAPHIC SCALE
1" = 100'
100 0 100 200

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY

SUBMITTED:
PROJECT ENGINEER
CHIEF, COASTAL DEVEL. SECT.
APPROVAL RECOMMENDED:
CORPS, PLANNING BRANCH

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
SURVEY MAP

APPROVED
CHIEF, ENGINEERING DIVISION
DATE OCT. 1970

SCALE 1"=100'
DRAWING NUMBER
SHEET 2 OF 3

PLATE NO. 3

CORPS OF ENGINEERS

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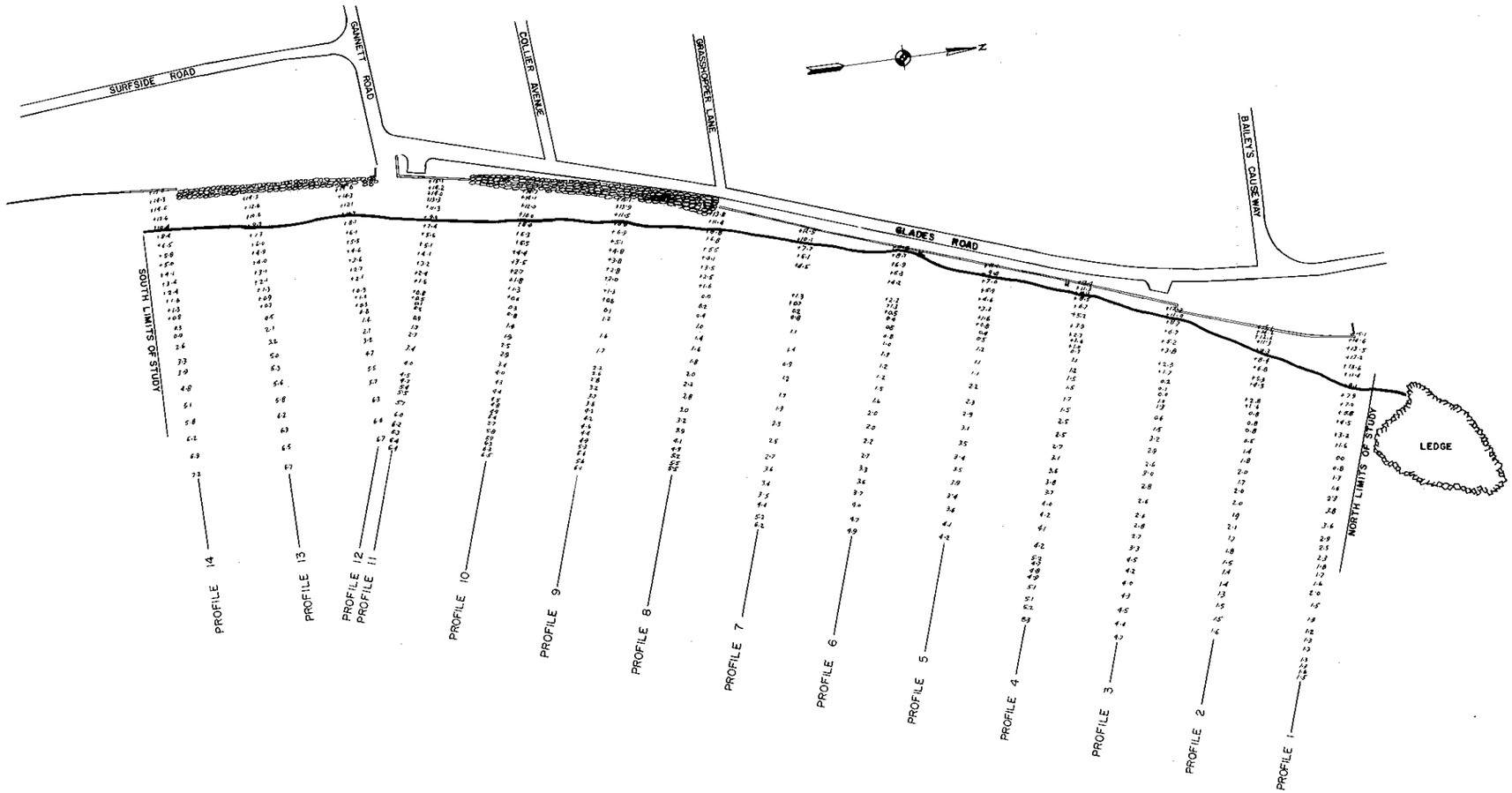


SURVEY MADE OCT. 1969

GRAPHIC SCALE
1" = 100'
100 0 100 200

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY

SUBMITTED:
PROJECT ENGINEER
CHIEF, COASTAL DEVEL. SECT.
APPROVAL RECOMMENDED:
CHIEF, PLANNING BRANCH

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT

NORTH SCITUATE BEACH
SCITUATE, MASS.

SURVEY MAP

APPROVED
DATE OCT. 1970
CHIEF, ENGINEERING DIVISION

SCALE 1"= 100'
DRAWING NUMBER

SHEET 3 OF 3

PLATE NO. 4

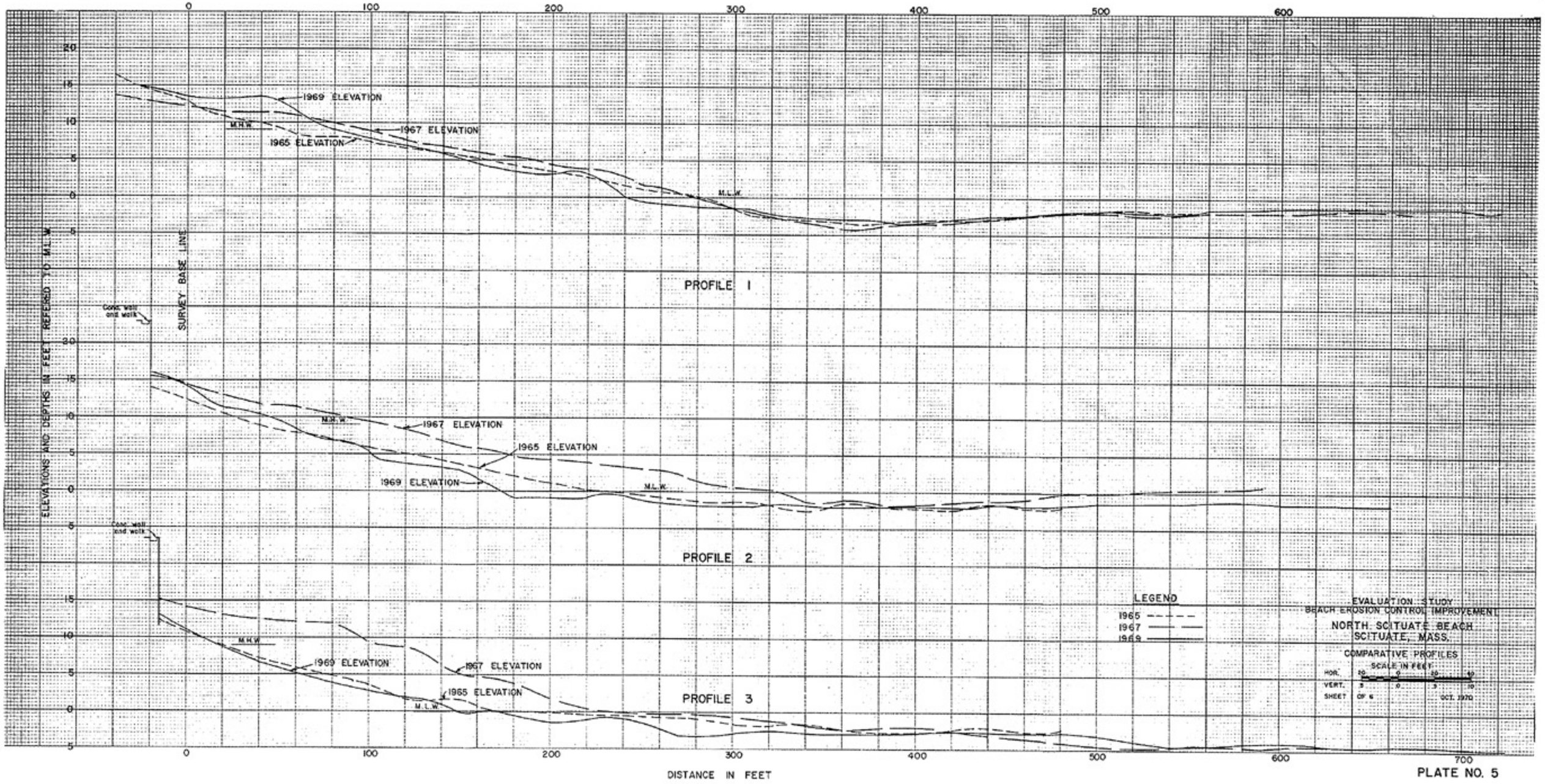

0
100
200
300
400
500
600
700
20
15
10
5
0
-5
ELEVATIONS AND DEPTHS IN FEET REFERED TO M.L.W.
SURVEY BASE LINE
Conc. wall and walk
1969 ELEVATION
M.H.W.
1967 ELEVATION
1965 ELEVATION
M.L.W.
PROFILE 1
PROFILE 2
PROFILE 3
LEGEND
1965
1967
1969
EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
COMPARATIVE PROFILES
SCALE IN FEET
HOR.
VERT.
SHEET
OF 6
OCT. 1970
DISTANCE IN FEET

PLATE NO. 5

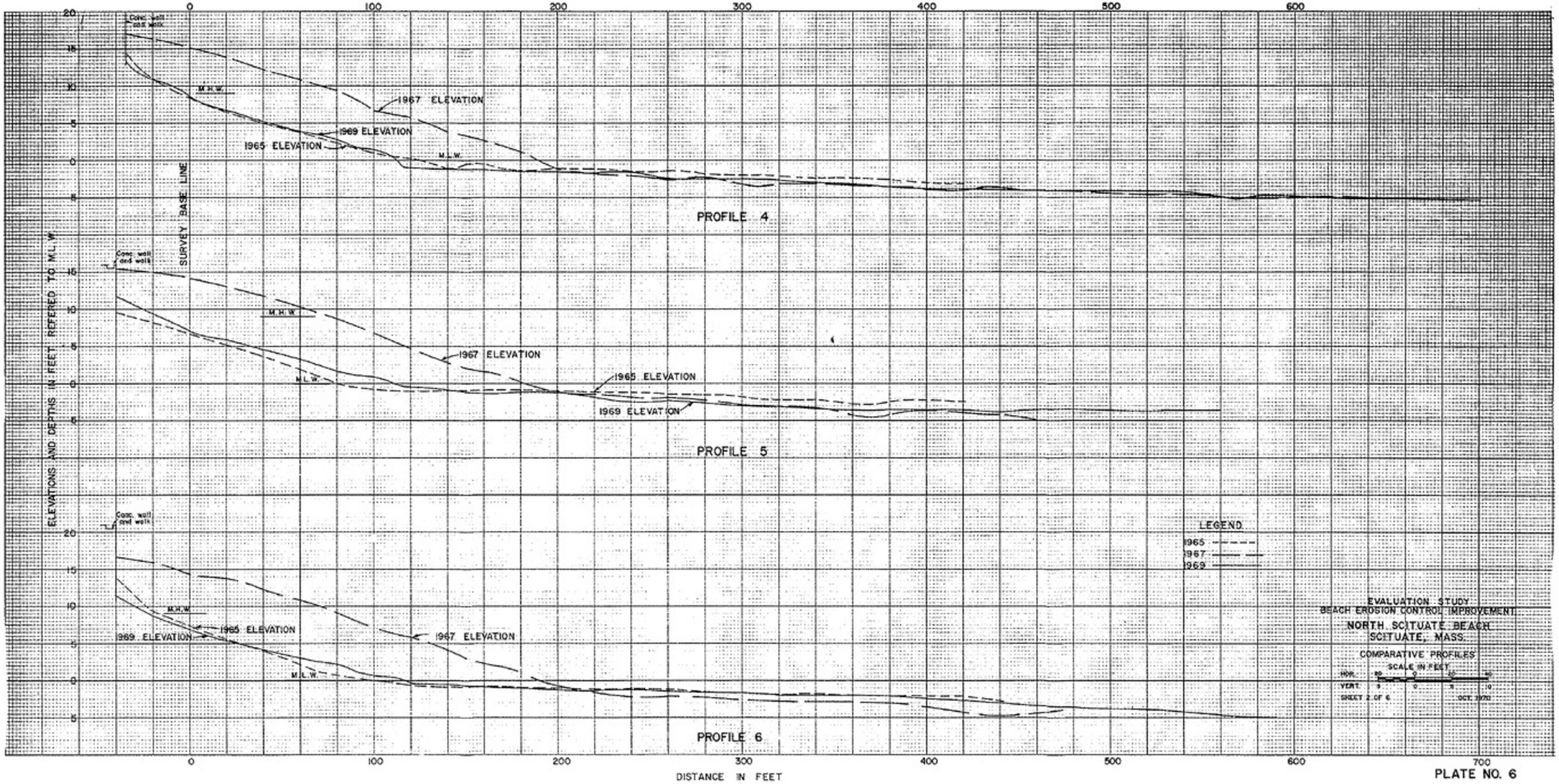
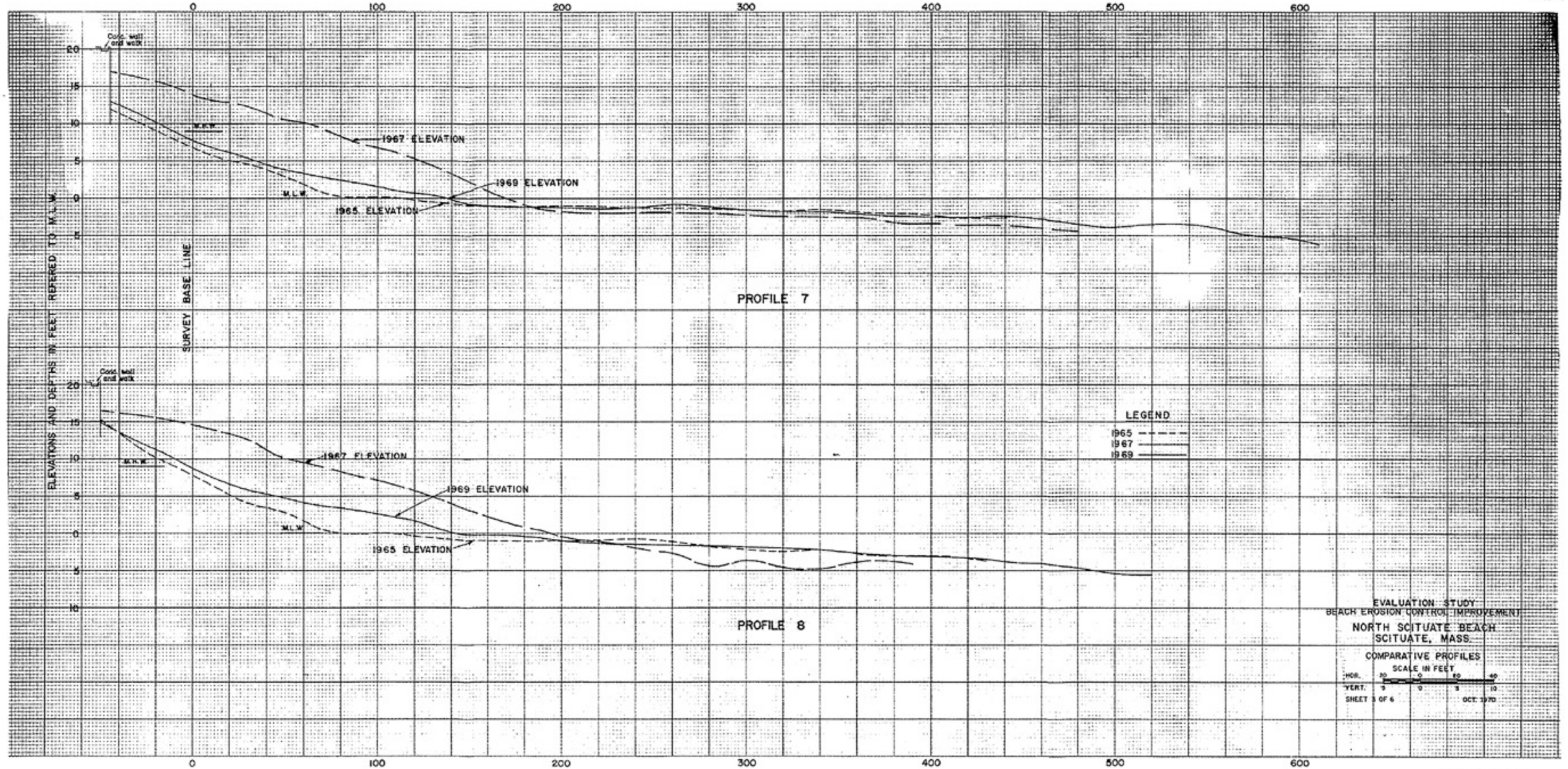

ELEVATIONS AND DEPTHS IN FEET REFERED TO M.L.W.
SURVEY BASE LINE
DISTANCE IN FEET
Conc. wall and walk
M.H.W.
M.L.W.
1967 ELEVATION
1969 ELEVATION
1965 ELEVATION
PROFILE 4
PROFILE 5
PROFILE 6
LEGEND
1965
1967
1969
EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
COMPARATIVE PROFILES
SCALE IN FEET
HOR.
VERT.
SHEET 2 OF 6
OCT. 1970

PLATE NO. 6



EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.

COMPARATIVE PROFILES

SCALE IN FEET
HOR. 20 0 20 40
VERT. 5 0 5 10

SHEET 3 OF 6

OCT. 1970

PLATE NO. 7

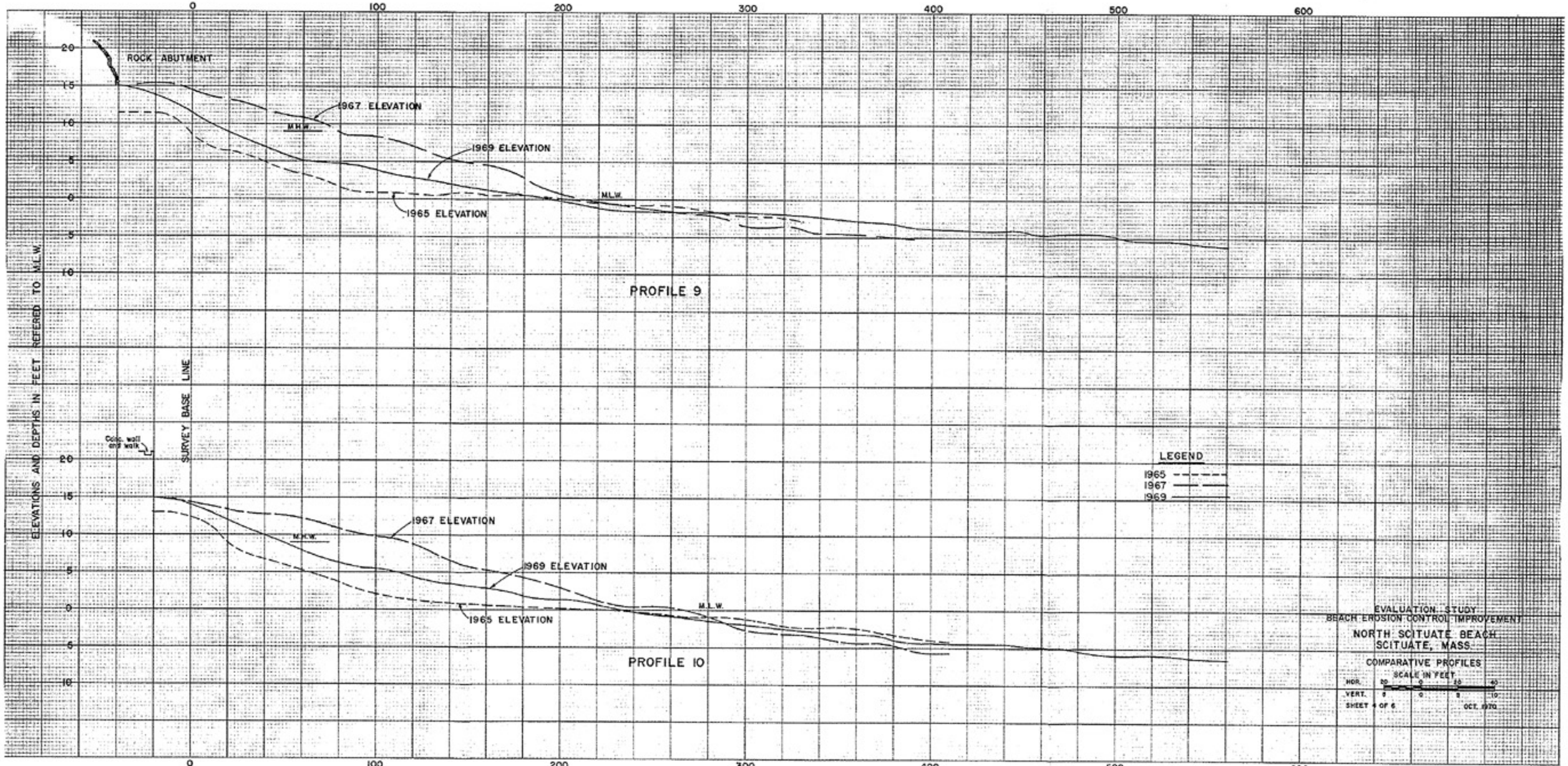

ELEVATIONS AND DEPTHS IN FEET REFERED TO M.L.W.
0
100
200
300
400
500
600
20
15
10
5
0
5
10
ROCK ABUTMENT
1967 ELEVATION
M.H.W.
1969 ELEVATION
M.L.W.
1965 ELEVATION
PROFILE 9
SURVEY BASE LINE
Conc. wall and walk
LEGEND
1965
1967
1969
1967 ELEVATION
M.H.W.
1969 ELEVATION
M.L.W.
1965 ELEVATION
PROFILE 10
EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
COMPARATIVE PROFILES
SCALE IN FEET
HOR. 20 0 20 40
VERT. 8 0 8 16
SHEET 4 OF 6
OCT. 1970
DISTANCE IN FEET

PLATE NO. 8

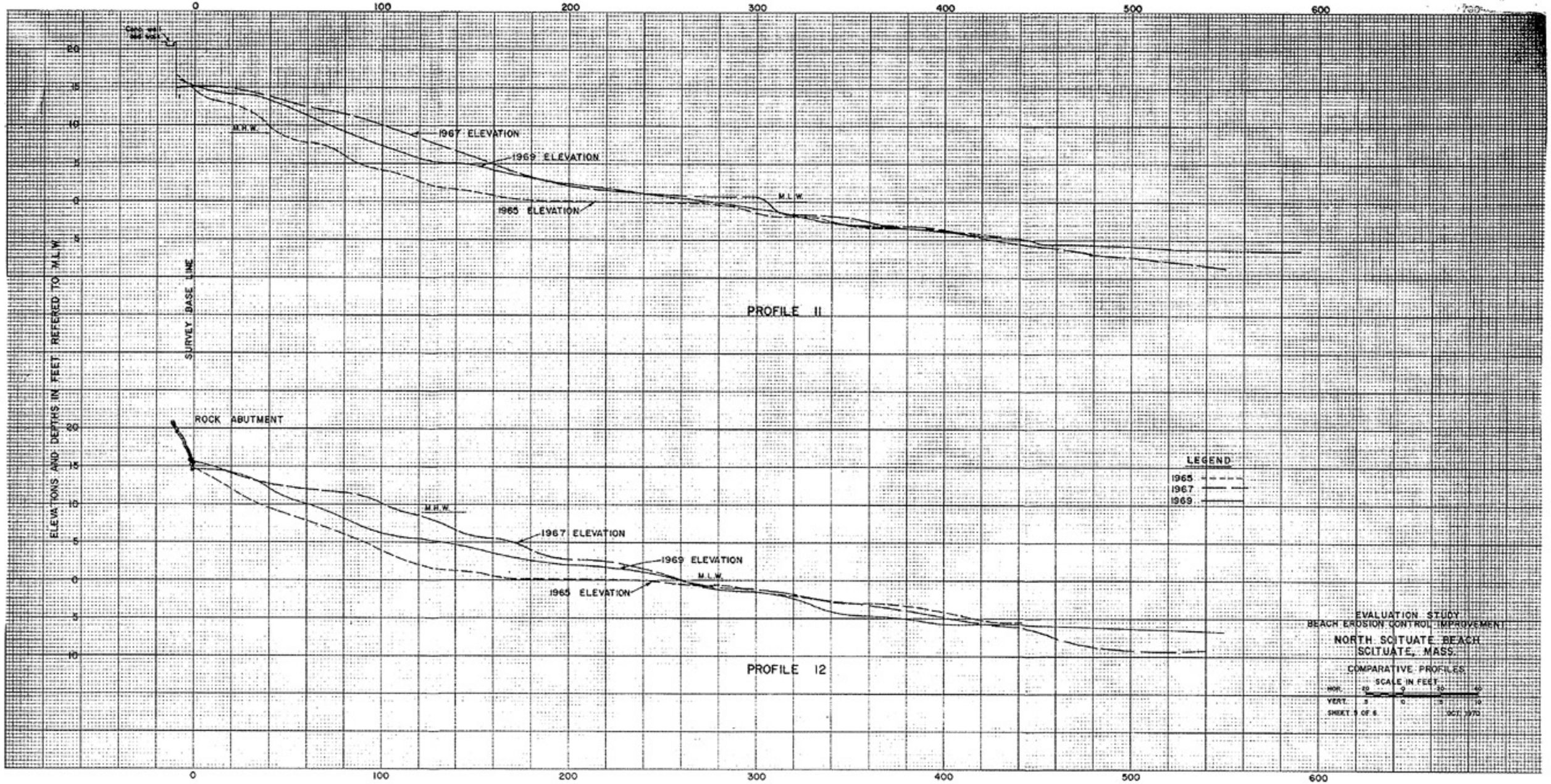

0
100
200
300
400
500
600
700
20
15
10
5
0
5
10
M.H.W.
1967 ELEVATION
1969 ELEVATION
1965 ELEVATION
M.L.W.
SURVEY BASE LINE
PROFILE 11
ROCK ABUTMENT
M.H.W.
1967 ELEVATION
1969 ELEVATION
M.L.W.
1965 ELEVATION
PROFILE 12
LEGEND
1965
1967
1969
ELEVATIONS AND DEPTHS IN FEET REFERED TO M.L.W.
DISTANCE IN FEET
EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
COMPARATIVE PROFILES
SCALE IN FEET
HOR. 20 0 20 40
VERT. 5 0 5 10
SHEET 3 OF 6
OCT. 1970

PLATE NO. 9

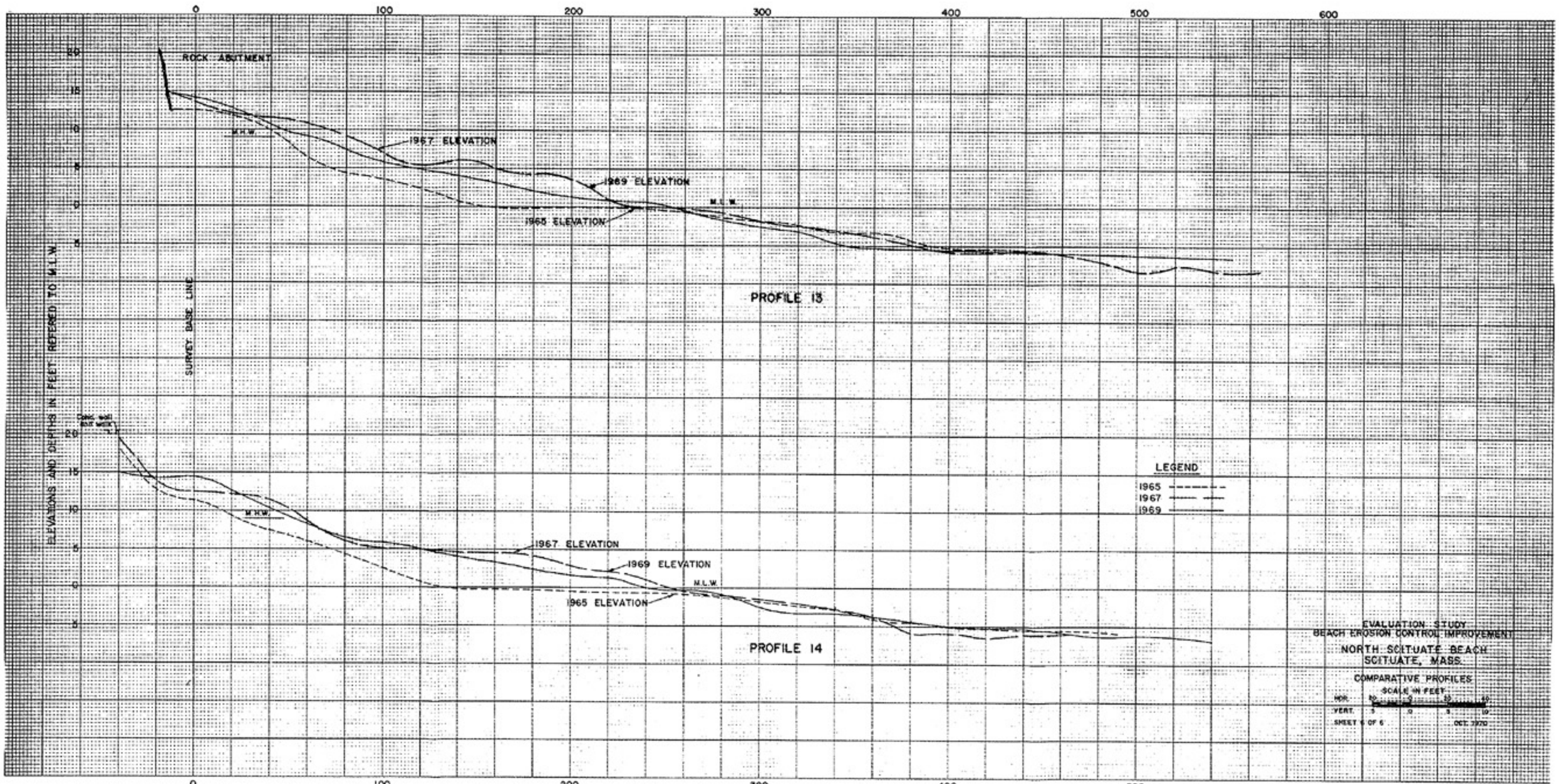

ROCK ABUTMENT
M.H.W.
1967 ELEVATION
1969 ELEVATION
M.L.W.
1965 ELEVATION
PROFILE 13
SURVEY BASE LINE
CONC. WALL
M.H.W.
1967 ELEVATION
1969 ELEVATION
M.L.W.
1965 ELEVATION
PROFILE 14
LEGEND
1965
1967
1969
ELEVATIONS AND DEPTHS IN FEET REFERED TO M.L.W.
DISTANCE IN FEET
0
100
200
300
400
500
600
20
15
10
5
0
5
EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
COMPARATIVE PROFILES
SCALE IN FEET
HOR. 20 0 20 40
VERT. 5 10 5 10
SHEET 6 OF 6
OCT. 1970

PLATE NO. 10

CORPS OF ENGINEERS

U. S. ARMY

GRAPHIC SCALE

1" = 100' 100 0 100 200

LEGEND

ENE DIRECTION

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY | TR. BY | CK. BY

SUBMITTED:

PROJECT ENGINEER

CHIEF, COASTAL DEVEL. SECT.

APPROVAL RECOMMENDED:

CHIEF PLANNING BRANCH

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT

NORTH SCITUATE BEACH
SCITUATE, MASS.

ORTHOGONAL PLOT

APPROVED

CHIEF, ENGINEERING DIVISION

DATE OCT. 1970

SCALE 1" = 100'

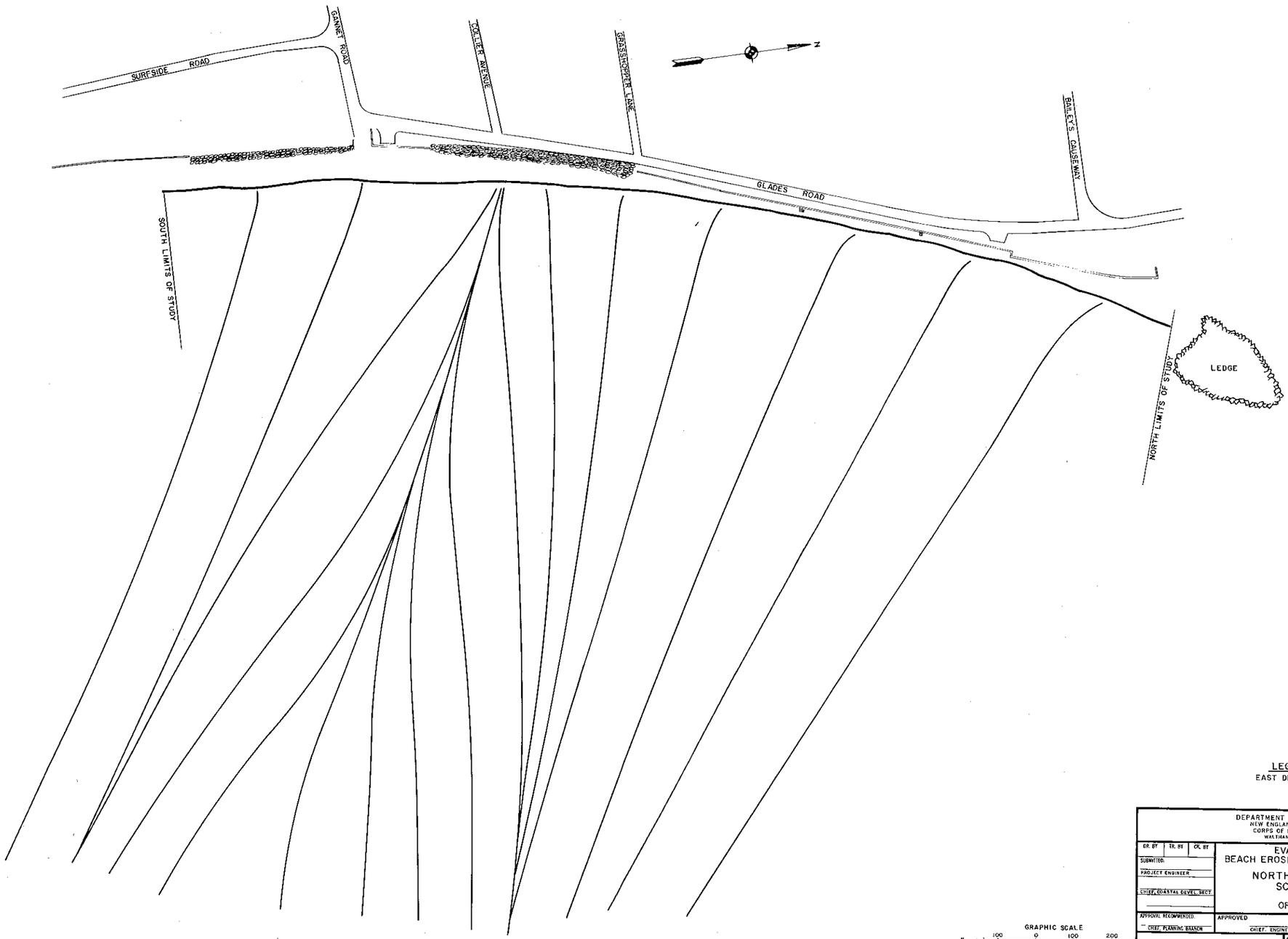
DRAWING NUMBER

SHEET 1 OF 3

PLATE NO. 11

CORPS OF ENGINEERS

U. S. ARMY



LEGEND
EAST DIRECTION

GRAPHIC SCALE
1" = 100'
100 0 100 200

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
SUBMITTED:		
PROJECT ENGINEER		
CHIEF, COASTAL DEVEL. SECT.		
APPROVAL RECOMMENDED:		
CHIEF, PLANNING BRANCH		

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
ORTHOGONAL PLOT

APPROVED
CHIEF, ENGINEERING DIVISION
DATE OCT. 1970

SCALE 1" = 100'
DRAWING NUMBER
SHEET 2 OF 3

PLATE NO. 12

CORPS OF ENGINEERS

U. S. ARMY

LEGEND

ESE DIRECTION

GRAPHIC SCALE

1" = 100'

100 0 100 200

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY

SUBMITTED:

PROJECT ENGINEER

CHIEF, COASTAL DEVEL. BRCH.

APPROVAL RECOMMENDED:

CHIEF, PLANNING BRANCH

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT

NORTH SCITUATE BEACH
SCITUATE, MASS.

ORTHOGONAL PLOT

APPROVED

DATE OCT. 1970

CHIEF, ENGINEERING DIVISION

SCALE 1" = 100'

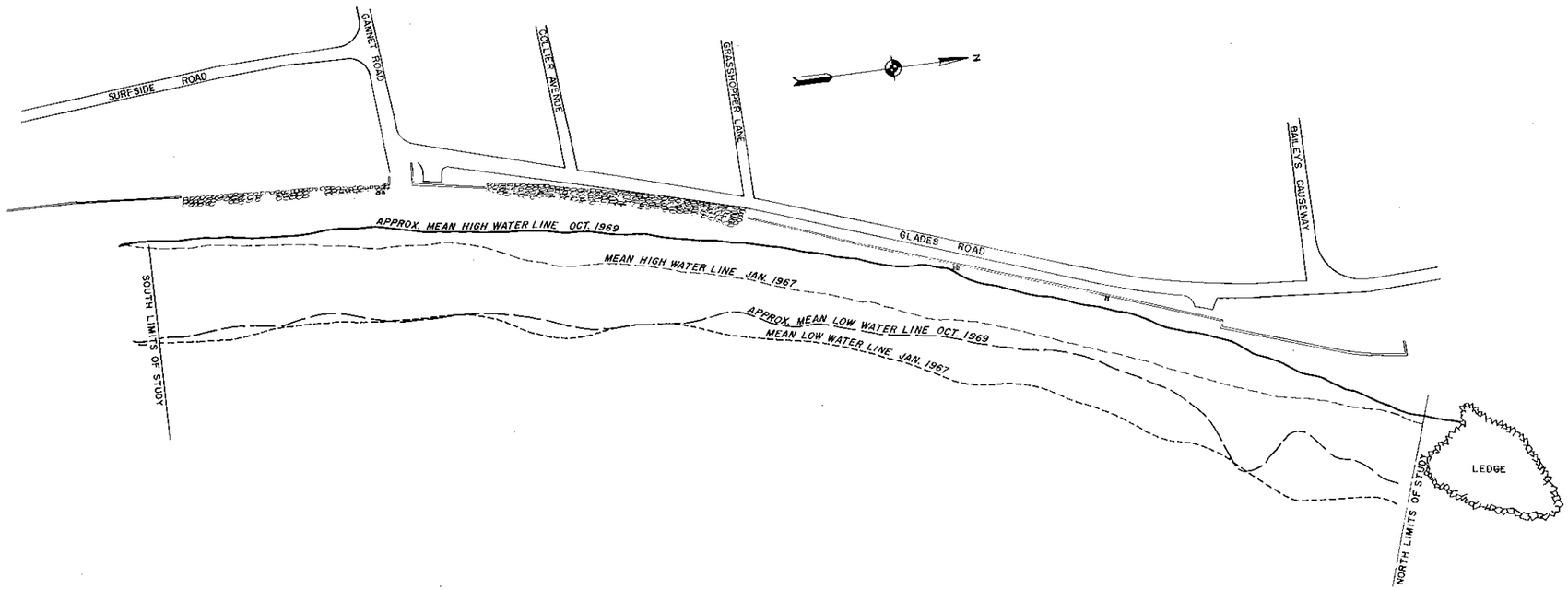
DRAWING NUMBER

SHEET 3 OF 3

PLATE NO. 13

CORPS OF ENGINEERS

U. S. ARMY



GRAPHIC SCALE
1" = 100'
100 0 100 200

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY

SUBMITTED:
PROJECT ENGINEER
CHIEF, COASTAL DEVEL. SECT.

APPROVAL RECOMMENDED:
CHIEF, PLANNING BRANCH

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.
SHORELINE CHANGE MAP

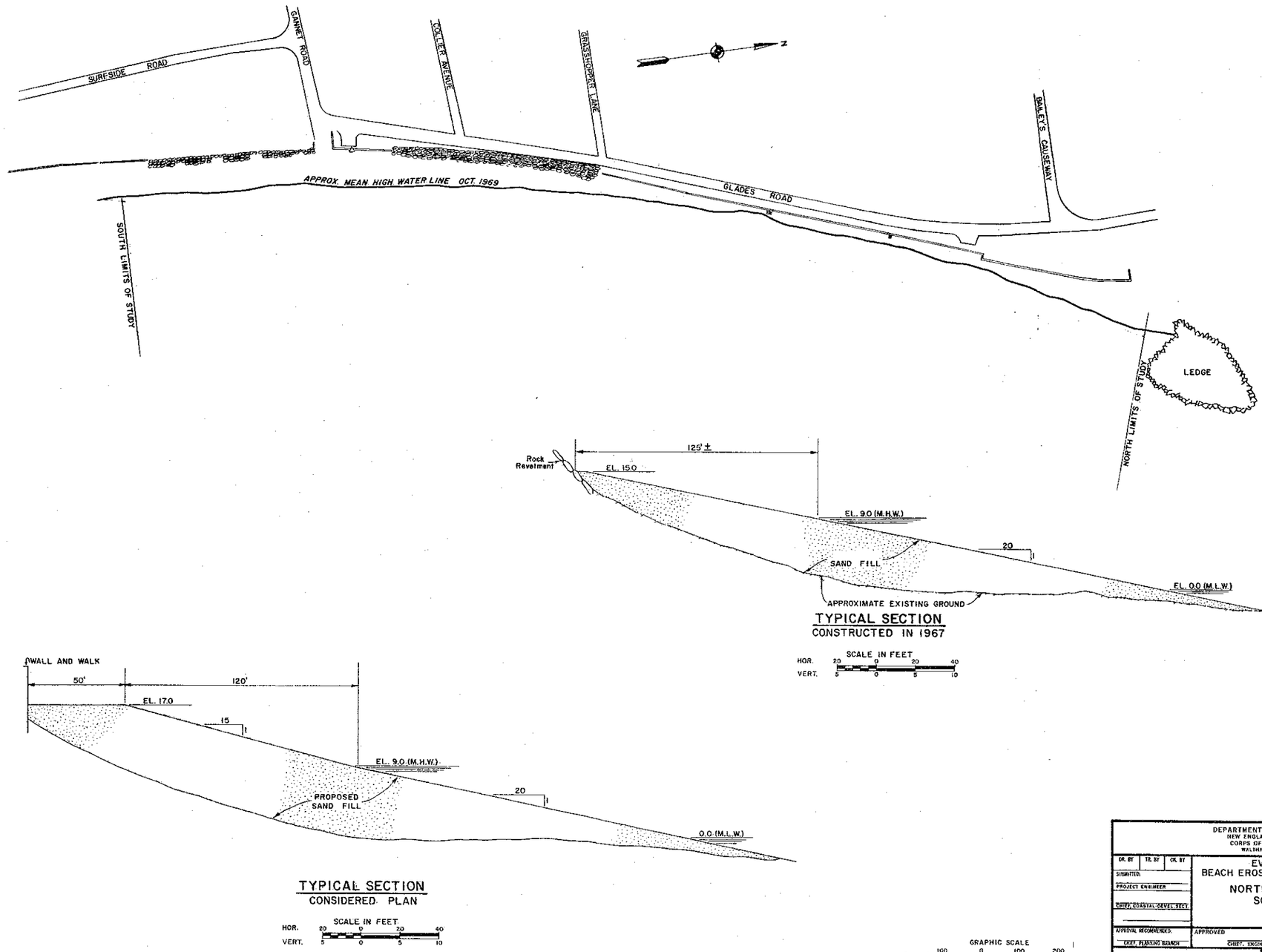
APPROVED
CHIEF, ENGINEERING DIVISION
DATE OCT. 1970

SCALE 1" = 100'
DRAWING NUMBER
SHEET 1 OF 1

PLATE NO. 14

CORPS OF ENGINEERS

U. S. ARMY



TYPICAL SECTION
CONSTRUCTED IN 1967

TYPICAL SECTION
CONSIDERED PLAN

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
SUBMITTED		
PROJECT ENGINEER		
CHIEF, COASTAL DEVEL. SECT.		
APPROVAL RECOMMENDED		
CHIEF, PLANNING BRANCH		

EVALUATION STUDY
BEACH EROSION CONTROL IMPROVEMENT
NORTH SCITUATE BEACH
SCITUATE, MASS.

APPROVED
CHIEF, ENGINEERING DIVISION

DATE OCT. 1970

SCALE AS SHOWN

DRAWING NUMBER

SHEET 1 OF 1

PLATE NO. 15